SPECIFICATION

1. Title of the Device

ELECTRICALLY CONDUCTIVE SHEET WITH GAS INTERCEPTION PROPERTY

2. Utility Model Claim

(1) An electrically conductive sheet with gas interception property, comprising carbon paper or carbon cloth impregnated with an electrically conductive fluorocarbon resin, and an electrically conductive fluorocarbon resin film having a periphery of larger dimensions than those of said carbon paper or carbon cloth on which said resin film is laminated, characterized in that the peripheral portion of said film is folded so that it covers said periphery of said carbon paper or carbon cloth.

3. Detailed Description of the Device

The present device relates to an electrically conductive sheet with gas interception property.

In a fuel cell, mutual single cells are electrically connected in series and diaphragms are

required for intercepting the fuel gas between the mutual single cells; in addition to gas interception property and electrical conductivity, it is required for the diaphragm to have such properties as chemical resistance to an electrolyte matrix, heat resistance, mechanical strength and the like.

A metal plate or a carbon plate has been conventionally used for the diaphragm, but there is a disadvantage that the metal plate is inferior in chemical resistance, or a specific plate having an excellent chemical resistance is expensive, and there is a disadvantage that the carbon plate is inferior in the mechanical strength (cracked readily).

The electrically conductive sheet with gas interception property in accordance with the present device can provide an excellent diaphragm in any one of the above properties, and has a constitution characterized in that carbon paper or carbon cloth impregnated with an electrically conductive fluorocarbon resin is laminated with an electrically conductive fluorocarbon resin film having a periphery of larger dimensions than those of the carbon paper or carbon cloth, and the peripheral portion of the film is folded in a way

that it covers the periphery of the carbon paper or carbon cloth.

The present device is described by way of the drawings as below:

Fig.1A shows a top view of the sheet of the present device, and Fig.1B shows a sectional view along the line b-b in Fig.1A, respectively.

In Fig.1A and Fig.1B, 1 designates carbon paper or carbon cloth impregnated with an electrically conductive fluorocarbon resin (hereinafter, referred to as a carbon cloth impregnated with an electrically conductive fluorocarbon resin) obtained by impregnating carbon paper or carbon cloth with an electrically conductive fluorocarbon resin dispersion and sintering the impregnated dispersion. 2 designates an electrically conductive fluorocarbon resin film with a periphery of larger dimensions than the carbon cloth 1 impregnated with an electrically conductive fluorocarbon resin; the resin film 2 is laminated with the above carbon cloth 1 impregnated with an electrically conducive fluorocarbon resin at one surface and the peripheral portion 21 of the film is folded in a way that it covers the periphery of the carbon cloth 1 impregnated with an electrically

conductive fluorocarbon resin. 3 denotes also carbon cloth impregnated with an electrically conductive fluorocarbon resin, which is laminated on the other surface of the electrically conductive fluorocarbon resin film 2.

The contact surfaces of the electrically conductive fluorocarbon resin film 2 with the carbon cloths 1 and 3, which are both impregnated with an electrically conductive fluorocarbon resin, are integrally adhered through thermal fusion respectively.

The above carbon cloth is made by weaving a carbon fiber, and the carbon paper is obtained by carding a carbon fiber to form a sheet of paper; commercially available products of them include, for example, as expressed by trade names, Toreca manufactured by Toray Industries, Inc., CE30 or CXO-100 manufactured by UNITIKA, Ltd., SH35 manufactured by NIPPON CARBON CO., LTD., or Besphite manufactured by Toho Rayon Co., Ltd.

As the electrically conductive fluorocarbon resin dispersion for impregnating the carbon paper, an aqueous dispersion is used containing a powder of fluorocarbon resin such as polytetrafluoroethylene (hereinafter referred to as PTFE), tetrafluoroethylene-

hexafluoropropylene copolymer (hereinafter referred to as FEP) and the like, in which an electrically conductive powder such as carbon, graphite and the like are dispersed. The formulating ratio of the fluorocarbon resin powder and the electrically conductive powder in the dispersion is determined depending on the kind, particle size and the like of the fluorocarbon resin powder or the electrically conductive powder, but usually 80 to 200 parts by weight of the electrically conductive powder is formulated to 100 parts by weight of the fluorocarbon resin powder. Further, it is preferable in view of impregnation of the dispersion in the carbon paper that the concentration of solid matter in the dispersion is adjusted to about 20 to 50% by weight.

Practically, a film of from about 30 to 100μ in thickness and having a volume resistance of 100$\Omega \cdot$cm or less is used as the electrically conductive fluorocarbon resin film. The fluorocarbon resin for making the film is not specifically limited, and there can be used PTFE, FEP, an ethylene-tetrafluoroethylene copolymer, a tetrafluoroethylene-perfluoroalkyl vinyl ether copolymer, and the like. Any of a product prior to calcination or a calcinated product can be used as the electrically

conductive fluorocarbon resin film; however, in the case when a fluorocarbon resin film which has not been calcinated is used, it is preferable that the fluorocarbon resin film is subjected to calcination either during or after its lamination with carbon paper, as it will provide an electrically conductive sheet with high degree of mechanical strength.

When the electrically conductive sheet shown in the above-mentioned Fig.1A and Fig.1B is brought in contact with an electrode plate of a fuel single cell using the folded face 20 of the electrically conductive fluorocarbon resin film 2 as a seal face (fusion adhesion seal), even if the carbon cloth 1 impregnated with an electrically conductive fluorocarbon resin has a gas permeability to a certain degree, because the cloth 1 is covered by the electrically conductive fluorocarbon resin film 2 in both of the thickness direction and the surface direction, the fuel gas of the single cell can be surely intercepted due to the excellent gas interception property of the film 2. Moreover, since the cloths impregnated with an electrically conductive resin, which are obtained by impregnating carbon cloths 1 and 3 with an electrically conductive resin, are excellent in

electrical conductivity, an excellent electrical conductivity is attained in the thickness direction of the whole of the electrically conductive sheet, even if the electrically conductive fluorocarbon resin film is not sufficiently high in electrical conductivity. Consequently electrical connection between single cells can be accomplished with remarkably low resistance.

In addition, it is needles to say that chemical resistance, thermal resistance and mechanical strength are excellent.

Fig.2 shows another Embodiment of the present device where bi-directional gas interception (indicated by arrows N and S) is provided, while in the first Embodiment shown in Fig.1, a single directional gas interception property is provided (indicated by arrow S in Fig.1). In Fig.2, the electrically conductive fluorocarbon resin films are denoted by 2 and 2, and the carbon cloths impregnated with an electrically conductive fluorocarbon resin are denoted by 1 and 1, respectively.

In Figs. 1A and 1B and Fig.2, the ratio of total thickness of the electrically conductive fluorocarbon resin films to total of the carbon cloths impregnated with an electrically conductive fluorocarbon resin is

usually from 10:1 to 3:1.

The present device is described in more detail by way of preferred Examples.

Examples

Carbon paper of 0.3 mm in thickness (Trade Name "Besphite" manufactured by Toho Rayon Co., Ltd.) was immersed into an aqueous dispersion (solid matter content 30% by weight) prepared by formulating 150 parts by weight of carbon powder to 100 parts by weight of un-calcinated PTFE powder, then the carbon paper was drawn out after to which the dispersion had been impregnated and dried for 5 minutes at room temperature.

Then the carbon paper is heated for 30 minutes at 100℃ for removal of water.

Then PTFE is calcinated for 5 minutes at 390℃ and thus carbon paper impregnated with an electrically conductive fluorocarbon resin was obtained.

Apart from the above, 150 parts by weight of carbon was formulated to 100 parts by weight of un-calcinated PTFE powder, and the resultant was molded into a film and heated at 390℃ for calcinations, thereby an electrically conductive fluorocarbon resin film of 80μ in thickness

is obtained.

Both the length and width of the electrically conductive fluorocarbon resin film were made to be 10 mm larger than those of the carbon paper impregnated with an electrically conductive fluorocarbon resin.

The carbon paper impregnated with an electrically conductive fluorocarbon resin was laminated with the electrically conductive fluorocarbon resin film by means of a hot press at 390℃ in such a way as shown in Figs. 1A and 1B and then was subjected to a folding process and maintained under the pressure of 25 kg/cm^2 for 30 minutes.

The volume resistance of the electrically conductive sheet thus obtained was measured and the result was 0.3 Ω-cm. In addition, Gas interception is measured and no gas permeation is observed.

Herein, the volume resistance was measured according to ASTM 257 and gas interception was measured using a gas permeation testing equipment (Rika Seiki Kogyo Co. Ltd., Gas Permeation Measuring Equipment Single A Type).

4. Brief Description of the Drawings

Fig.1A is an explanatory top view showing an

electrically conductive sheet material of the present device, Fig.1B is an explanatory cross-sectional view taken along line b-b in Fig.1A, and Fig.2 is an explanatory cross-sectional view showing another embodiment of the present device.

In the Figs., the numeral 1 denotes carbon cloth impregnated with an electrically conductive fluorocarbon resin, the numeral 2 denotes an electrically conductive fluorocarbon resin film, and the numeral 21 denotes a peripheral portion of the film.

明　細　書

1. 考案の名称

ガス遮断性を有する導電性シート

2. 実用新案登録請求の範囲

(1) 導電性フッ素樹脂を含浸したカーボンペーパ又はカーボンクロスにこれよりも周囲寸法の大なる導電性フッ素樹脂フィルムを積層し、上記カーボンペーパ又はカーボンクロスの周囲に上記フイルムの周縁部を折曲により被覆したことを特徴とするガス遮断性を有する導電性シート。

3. 考案の詳細な説明

本考案はガス遮断性を有する導電性シートに関するものである。

燃料電池においては、単電池相互を直列に電気的に導通すると共に単電池相互間における燃料ガスを遮断するための隔膜が必要であり、この隔膜にはガス遮断性、導電性の他、電解質マトリックスに対する耐薬品性、耐熱性、機械的強度等が要求される。

従来、上記隔膜に金属板又はカーボン板を使用しているが、金属板においては耐薬品性に劣り、又は耐薬品性に秀れた特殊なものでは高価であるといつた不利があり、カーボン板においては機械的強度に劣る（割れ易い）といつた不利がある。

本考案に係るガス遮断性を有する導電性シートは、上記何れの特性にも秀れた隔膜を供し得るものであり、導電性フツ素樹脂を含浸したカーボンペーパ又はカーボンクロスにこれよりも周囲寸法の大なる導電性フツ素樹脂フイルムを積層し、上記カーボンペーパ又はカーボンクロスの周囲に上記フイルムの周縁部を折曲により被覆したことを特徴とする構成である。

以下、図面により本考案を説明する。

第１図Ａは本考案シートの上面図を、第１図Ｂは第１図Ａにおけるｂ－ｂ断面をそれぞれ示している。

第１図Ａ並びに第１図Ｂにおいて、１はカーボンペーパ又はカーボンクロスに導電性フツ素

樹脂デイスパージヨンを含浸し、この含浸デイスパージヨンを焼結してなる導電性フッ素樹脂含浸カーボンペーパ又はクロス（以下、導電性フッ素樹脂含浸カーボンクロスと称す）である。２は導電性フッ素樹脂フイルムであり、その周囲寸法を上記の導電性フッ素樹脂含浸カーボンクロス１の周囲寸法よりも大とし、他面において上記導電性フッ素樹脂含浸カーボンクロス１に積層し、フイルム周縁部２１を折曲して導電性フッ素樹脂含浸カーボンクロス１の周囲に被覆してある。３も導電性フッ素樹脂含浸カーボンクロスであり、導電性フッ素樹脂フイルム２の他面に積層してある。

この導電性フッ素樹脂フイルム２と導電性フッ素樹脂含浸カーボンクロス１，３との接触面は熱融着により一体化してある。

上記のカーボンクロスはカーボン繊維を織つたものであり、カーボンペーパは、カーボン繊維を紙状に抄いて得られるもので、市販品としては例えば東レ社製商品名トレカ、ユニチカ社

製商品名CE30或いはCXO−100、日本カーボン社製商品名SH35、東邦レーヨン社製商品名ベスファイト等を挙げることができる。

カーボンペーパに含浸せしめる導電性フッ素樹脂デイスパージョンとしてはポリテトラフルオロエチレン（以下、PTFEと称す）、テトラフルオロエチレン−ヘキサフルオロプロピレン共重合体（以下、FEPと称す）等のフッ素樹脂粉末にカーボン、グラファイト等の導電性粉末を分散せしめた水性デイスパージョンが用いられる。このデイスパージョンにおけるフッ素樹脂粉末と導電性粉末の配合割合は、フッ素樹脂或いは導電性粉末の種類や粒径等に応じて設定するが、通常はフッ素樹脂粉末100重量部に対し、導電性粉末80〜200重量部である。なお、デイスパージョン中における固形分濃度は約20〜50重量%に設定するのが、カーボンペーパへの含浸のために好ましい。

導電性フッ素樹脂フイルムとしては厚さ約30〜100μ、体積抵抗100Ω·cm以下のものが実用

的である。このフイルムを形成するためのフッ素樹脂は特に限定されるものではなく、ＰＴＦＥ、ＦＥＰ、エチレン－テトラフルオロエチレン共重合体、テトラフルオロエチレン－パーフルオロアルキルビニルエーテル共重合体等を用いることができる。この導電性フッ素樹脂フイルムは未焼成品或いは焼成品のいずれも用いることができるが、未焼成フッ素樹脂フイルムを用いた場合には、該フイルムと前記カーボンペーパの積層時或いは積層後に該フッ素樹脂フイルムを焼成すると、機械的強度の特に大きな導電性シートが得られるので、好適である。

上記第１図Ａ並びに第１図Ｂにより示す導電性シートを導電性フッ素樹脂フイルム２の折返えし面２０をシール面（熱融着シール）として燃料単電池の極板に当接する場合、導電性フッ素樹脂含浸カーボンクロス１がある程度通気性を有していても、このクロス１を厚み方向、面方向の何れに対しても導電性フッ素樹脂フイルム２で覆つてあるから、このフイルム２の秀れ

たガス遮断性のために、単電池の燃料ガスを確実に遮断できる。又、導電性フッ素樹脂フイルム２の導電性がそれほど高くなくても、導電性に秀れたカーボンクロス１，３に導電性樹脂を含浸してなる導電性樹脂含浸クロスの導電性が著しく高いから、導電性シート全体の厚み方向の導電性を極めて高くでき、単電池間を著しく低抵抗で導通できる。

更に、耐薬品性、耐熱性、機械的強度に秀れていることは勿論である。

第２図は本考案の別実施例を示しており、第１図に示した実施例が一方向（第１図のＳで示す）のガス遮断性を有するのに対し、両方向（Ｓ並びにＮで示す）のガス遮断性を備えている。第２図において、２，２は導電性フッ素樹脂フイルムを、１，１は導電性フッ素樹脂含浸カーボンクロスをそれぞれ示している。

第１図Ａ，Ｂ並びに第２図において、導電性フッ素樹脂フイルムの総厚みと導電性フッ素樹脂含浸カーボンクロスの総厚みとの比は、通常

１０：１～３：１である。

以下、実施例により本考案を更に詳細に説明する。

実施例

未焼成のＰＴＦＥ粉末１００重量部に対しカーボン粉末１５０重量部を配合した水性デイスパージヨン（固形分濃度３０重量％）中に厚さ０.３㎜のカーボンペーパ（東邦レーヨン社製商品名ベスフアイト）を浸漬し、カーボンペーパにデイスパージヨンを含浸せしめて引き上げ、室温で５分間風乾する。

次に、１００℃の温度で３０分間加熱し水分を除去する。

その後、３９０℃の温度で５分間加熱することによりＰＴＦＥを焼成し、導電性フツ素樹脂含浸カーボンペーパを得る。

一方、これとは別に未焼成ＰＴＦＥ粉末１００重量部に対し、カーボン１５０重量部を配合して、フイルム状に成形し、更に３９０℃に加熱して焼成し、厚さ８０μの導電性フツ素樹脂フイルム

を得る。

この導電性フツ素樹脂フイルムの縦巾並びに横巾とも上記導電性フツ素樹脂含浸カーボンペーパに較べて１０㎜大としてある。

この導電性フツ素樹脂含浸カーボンペーパ並びに導電性フツ素樹脂フイルムを３９０℃のホットプレスを用い第１図Ａ並びに第１図Ｂに示すように積層し、折曲加工を行い、圧力２５㎏/㎠にて３０分間保持した。

このようにして得た導電性シートの体積抵抗を測定したところ０.３Ω－㎝であつた。又、ガス遮断性を測定したところガス透過は認められなかつた。

なお、体積抵抗はＡＳＴＭ２５７により測定し、ガス遮断性はガス透過試験機（理化精機工業社製、気体透過測定装置単式Ａ型）により測定した。

4. 図面の簡単な説明

第１図Ａは本考案に係る導電性シートを示す上面説明図、第１図Ｂは第１図Ａにおけるｂ－

ｂ断面説明図、第２図は本考案の別実施例を示す断面説明図である。

図において、１は導電性フッ素樹脂含浸カーボンクロス、２は導電性フッ素樹脂フイルム、２１はフイルム周縁部である。

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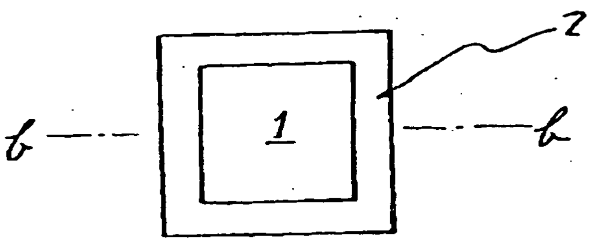
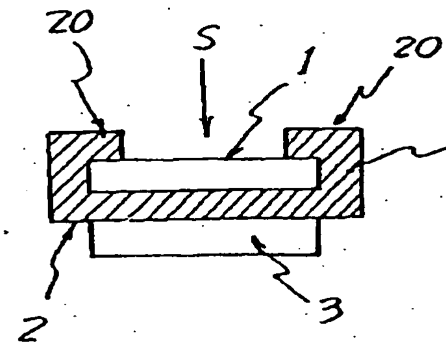
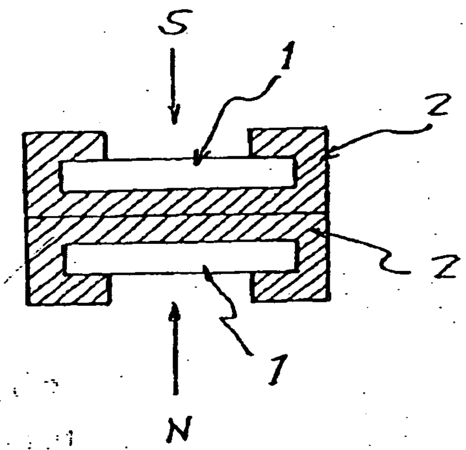


第1図A
Fig. 1A



第1図B
Fig. 1B



第2図
Fig. 2

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